NECK TRAUMA

Introduction

Traumatic neck injuries can be life-threatening, with potential for aerodigestive or vascular injury. The majority of injuries are penetrating, with blunt trauma accounting for only 5% of neck trauma cases. Airway occlusion or vascular catastrophe is the most immediately recognisable and rapidly fatal complication. Aerodigestive tract injuries are often more insidious, but also constitute a potential life threat.

Anatomical Considerations: Zones of the Neck

Anatomically the neck has been categorised into 3 zones – first described by Monson et al in 1969. Over the years this has had implications with respect to assessment and operative management. Surgical access is difficult in zones I and III. Considering the neck in terms of injury zones can be helpful when considering potential structures at risk of injury.

Zonal Classification of the Neck:

Zonal contents:

I. Clavicles to cricoid

- Vertebral and proximal carotid arteries
- Major thoracic vessels
- Superior mediastinal structures
- Lungs
- Oesophagus
- Trachea
- Thoracic duct
- Spinal cord
- Sympathetic ganglion/chain

Note: Injuries in this zone pose a very real risk to superior thoracic structures

II. Cricoid to Angle of Mandible

- Vertebral and carotid arteries
- Jugular veins
- Oesophagus
- Trachea
- Larynx
- Spinal cord
- Sympathetic chain

III. Angle of mandible to Base of Skull

- Upper vertebral and carotid arteries
- Pharynx
- Spinal cord
- Sympathetic ganglion/chain

Note: Injuries to this zone pose a real risk to intracranial structures

BLUNT NECK TRAUMA

The most common mechanism of blunt neck trauma in our patient population is motor vehicle accident with either rapid deceleration injuries or direct impact against the steering wheel or dash. Strangulation from hanging, choking, ‘clothes line’ injury or manual strangulation are not uncommon. Direct blows from fists, feet and other weapons account for the remainder.

Spinal injuries (addressed in Spinal Injury module)

- Hangman’s # potential with judicial hanging (drop greater than patient’s height)

Tracheolaryngeal injuries

- Transections (76% of these occur within 2 cm of carina)
- Tears
- Contusion/oedema
- Cartilage fractures

Blunt tracheolaryngeal injuries are uncommon, ranging from contusion and mucosal oedema to tracheal tears and transections. The majority of injuries occur close to the carina (see above). The primary issue in tracheolaryngeal injuries is resulting airway compromise.

Vascular injuries

- Dissection
- Thrombosis

Blunt vascular injuries involving the carotid or vertebral arteries are rare but potentially devastating events. Rates of injury are quoted as 0.1% of all trauma patients increasing to 1% when an active screening process is undertaken and 2.7% of patients with Injury Severity Score (ISS) ≥ 16. Prior to screening, the majority of asymptomatic Blunt Cervical Vascular Injury (BCVI) were diagnosed only after the development of symptoms secondary to the resulting CNS ischaemia, with morbidity and mortality of up to 80% and 40% respectively. Early treatment decreases the likelihood of permanent neurological dysfunction if these initially occult lesions are identified and treated, hence the importance of a high degree of suspicion and screening.

Dedicated CT angiogram of the neck vasculature should be undertaken in patients with high risk features for blunt cerebrovascular injuries.

The most accepted mechanisms of BCVI are:

- Cervical hyperextension or hyperflexion with rotation/stretching of the internal carotid over the lateral articular processes of the vertebral bodies of C1-C3
- Direct trauma
• Basilar skull fracture involving the carotid canal
• C-spine fractures causing vertebral artery injury particularly subluxations and fractures involving the transverse processes and fractures extending through the transverse foramen.

Assessment

The goals of assessment are to identify life threatening airway issues secondary to tracheobronchial injury or expanding neck haematoma, along with neurology associated with cerebrovascular injury.

Imaging

CTA (CT Angiogram of Neck Vessels)

CTA is the imaging modality of choice. High-risk features which indicate the need for CTA screening in blunt neck trauma include\(^3,4,5\):

- Injury mechanism:
  - Severe cervical hyperextension / rotation or hyperflexion
- Significant traumatic brain injury:
  - Diffuse Axonal Injury (DAI) with GCS ≤ 8
- Suspected or demonstrated fracture in proximity to the internal carotid or vertebral artery:
  - Suspected / demonstrated cervical spine fracture, in particular fractures of C1-C3, fractures involving the transverse foramen, cervical subluxation or significant rotation
  - Basilar skull fracture involving carotid canal
  - Petrous bone involvement
- Near hanging with anoxic brain injury
- Physical signs
  - Seat belt abrasion to neck
  - Soft tissue injury to the anterior neck
  - Expanding neck haematoma
  - Cervical bruit
  - Arterial epistaxis
  - Focal neurological deficit including anisocoria, Horner’s syndrome, vertebrobasilar insufficiency
  - Neurological abnormality not explained by a concurrently diagnosed injury
- Evidence of cerebral infarction on CT Brain
- Other major injury above the clavicle i.e. Le Fort II or III

A grading scale for cervical vascular injury has been put forward as follows\(^3\):

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>intimal irregularity with &lt; 25% luminal narrowing</td>
</tr>
<tr>
<td>II</td>
<td>dissection or intraluminal haematoma with &gt; 25% narrowing</td>
</tr>
<tr>
<td>III</td>
<td>pseudoaneurysm</td>
</tr>
<tr>
<td>IV</td>
<td>occlusion</td>
</tr>
<tr>
<td>V</td>
<td>transection with extravasation</td>
</tr>
</tbody>
</table>

Specific Management

Tracheobronchial Injuries

The mainstay of airway management is, where possible, to maintain spontaneous respirations until a tube is placed distal to the injury – ideally a tracheostomy (under local anaesthesia)
performed in the operating theatre. **Fibre-optic laryngoscopy** is crucial to visualise the anatomy and to determine the presence and extent of any mucosal or cartilaginous injury.

**Vascular Injuries**

Treatment is directed towards prevention or progression of neurological compromise or deficit. Anticoagulation and antiplatelet therapy are the mainstays of treatment and the potential benefit of treatment needs to be weighed against the risk of bleeding in a multi-trauma patient. All cases should be discussed with Vascular Surgery as well as the treating teams of other systems injured. There is insufficient evidence to mandate one treatment strategy over another, although stroke rates are lower in treated patients. Endovascular therapy may be considered for carotid pseudoaneurysm and, rarely, for accessible carotid lesions associated with very early neurology. Antiplatelet therapy is likely to be required peri-procedurally. Most lesions are not amenable to surgical intervention given their location.

**PENETRATING NECK TRAUMA**

**Introduction**

Penetrating injuries to the neck that penetrate the platysma are primarily caused by gunshot or stab wounds. The major associated injuries of concern are aerodigestive tract and vascular.

Stabbings typically have lower surrounding tissue injury than gunshot wounds. The surface entry site alone is not an accurate predictor of the trajectory or depth of a stab wound. These sites should not be probed blindly as it may dislodge haematoma. Embedded weapons e.g. knives, should not be removed in the emergency department.

Gunshot wounds typically cause more collateral damage. Low velocity missiles, produced by handguns, birdshot or buckshot cause relatively limited damage along the projectile path. High velocity wounds produced by rifle or close-range blasts produce more severe damage. The shockwave effect on surrounding tissues can create an injury zone up to 30 times greater than the actual missile size.

**Assessment**

The goal of assessment is to rapidly identify any immediate life threats, primarily airway or vascular, to allow prioritisation of management.

The presence of hard signs of injury on assessment has a reasonably high specificity for surgically significant injury and indicates the need for emergent surgical exploration without further diagnostic testing. Patients with no signs have a very low likelihood of surgically significant injury.
## Hard Signs of Significant Injury

### VASCULAR
- Pulsatile/severe haemorrhage
- Expanding/pulsatile haematoma
- Shock
- Evolving stroke / neurological deficit
- Bruit/thrill

### AIRWAY
- Airway/respiratory compromise
- Massive subcutaneous emphysema
- Air bubbling through wound

### OESOPHAGEAL
- Haematemesis
- Dysphagia
- Odynophagia

**some texts describe this as a hard sign**

## Imaging

Early consensus guidelines on penetrating neck trauma advocated for mandatory surgical exploration of most penetrating neck trauma. In particular, all Zone II injuries penetrating deep to platysma were routinely explored because of concern around missed oesophageal injuries, irrespective of the presence or absence of hard /soft signs of injury. With the high incidence of negative exploration rate (as high as 75% in one series), more recent reports advocate a selective approach to exploration based on the absence of hard signs and investigation results.

**Chest XRay (CXR)**
Essential in the trauma patient. It can quickly demonstrate haemopneumothorax or subcutaneous emphysema.

**CT angiography**
CTA will detect most surgically significant injury with a sensitivity approaching 100% and specificity of 97.5% for clinically significant injuries. In the Australian environment, CTA is typically first-line to investigate soft signs of vascular or aerodigestive injury in all zones, given its high sensitivity coupled with our lack of regular exposure to these injury patterns.

Given the inherently more difficult surgical exposure of Zones I and III and the growing role of endovascular procedures, CTA of Zone I and III is often used to plan intervention to injuries in these areas. It is important to note, however, that CTA can miss IJV, oesophageal and thoracic duct injuries.
**Angiography**
Angiography, while gold standard for determining vascular injury, carries logistic and economic constraints as well as potential complications including thrombosis, dissection and embolisation. It is no longer routinely used in the work-up of these patients.

**Vascular Duplex**
Duplex can be used to visualise neck vasculature. While portable and minimally invasive, duplex can miss small intimal tears and obtaining adequate images can be technically difficult in the presence of significant haematoma or subcutaneous emphysema.

**Fibre-optic nas-endoscopy/bronchoscopy**
Fibre-optic visualisation is first line for the injured upper airway and trachea.

**Contrast swallow & Endoscopy**
Both contrast swallow and endoscopy are typically used to visualise the gastrointestinal tract if there is clinical suspicion of an injury.

Patients with soft signs will typically require CTA neck along with nas-endoscopy or bronchoscopy and contrast swallow / endoscopy if digestive injuries are suspected. Patients with no signs should be investigated or observed based on clinical grounds.

**Management**

**Position**
In penetrating neck trauma, patients typically prefer to be seated upright – particularly if there are any symptoms of airway compromise.

If there is clinical concern regarding a potential spinal cord injury, spinal immobilisation may be necessary. Typically these patients can still be managed head up with the whole bed tilted. The rate of spinal injury in penetrating neck wounds is very low with 0.15% stab wounds and 1.35% gun shot wounds having concurrent cervical fracture.²

**Airway & Breathing**

**Airway stabilisation is the first priority.**

Given the nature of the injury – with the potential for direct tracheal injury, oedema/haematoma or secretions/haemorrhage – **a difficult airway should be anticipated.**

ENT and anaesthetic team should be notified early if there is suspicion of an airway injury – consideration of a primary tracheostomy should be given.

If airway compromise is imminent prior RSI is necessary.

Consideration can be given to utilising techniques reserved for difficult airways including:

- with-holding muscle relaxants until it is known a view of the cords is achievable – typically through gentle laryngoscopy with ketamine sedation
- using video assisted laryngoscope to facilitate intubation (may be complicated with blood in the airway)
With a visibly transected/injured trachea intubation may be achieved directly through the exposed airway defect.

**Circulation**

**Haemorrhage Control** with direct pressure

**Foley catheter balloon tamponade** has been described as a method to control rapid bleeding in vascular injuries to the neck. Success rates have been published in small trials to be between 50-94%. The technique is more amenable to venous injuries.

**Supportive Therapy**

- Keep patient warm
- Correct any coagulopathy

**Disposition**

- Disposition is typically to the operating theatre with a multidisciplinary team including ENT, Vascular and Upper GI surgeons in patients with significant penetrating neck trauma.
- Patients with airway-threatening injury require ongoing close observation in the intensive care unit or dedicated trauma high-dependency units.
- Patients with soft signs and imaging evidence of underlying injury usually required operative intervention, particularly injuries in Zone II.
- Patients with soft signs and a negative work-up should be observed for a period of time or until symptoms resolve

**References**


